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MECHANICS.

348. Proposed by ALTON L. MILLER, Ann Arbor, Michigan.

If equilateral triangles be constructed on the sides of any triangle, their centers are the vertices of a new equilateral triangle. Show that the center of gravity of this new equilateral triangle coincides with the center of gravity of the original triangle.

349. Proposed by S. A. COREY, Albia, Iowa.

A 9 pound weight is attached to a string which passes over a smooth fixed pulley. The other end of the string is fastened to and supports a smooth pulley P_1 of weight 1 pound, over which passes a second string to one end of which is attached a 3 pound weight, and the other end of which is attached to and supports another smooth pulley P_2 of weight 1 pound. Over the pulley P_2 passes a third string supporting weights, 2 pounds and $3\frac{1}{3}$ pounds.

If the system is acted on by gravity alone show that the accelerations of the 9 pound weight, $3\frac{1}{3}$ pound weight, and pulley P_2 are 0, $\frac{1}{2}g$, and $\frac{1}{32}g$, respectively.

Determine the motion of the weights when pulleys are not smooth, that is, when friction is present.

NUMBER THEORY.

266. Proposed by J. L. RILEY, Tahlequah, Oklahoma.

In how many ways can a given number be polygonal?

267. Proposed by C. C. YEN, Tangshan, North China.

A number theory function $\phi(n)$ is defined for every positive integer n, and for every such number n, it satisfies the relation $\phi(d_1) + \phi(d_2) + \cdots + \phi(d_\tau) = n$. From this property alone show that

$$\phi(n) = n\left(1 - \frac{1}{p_1}\right)\left(1 - \frac{1}{p_2}\right)\cdots\left(1 - \frac{1}{p_k}\right),$$

where $p_1, p_2, p_3, \cdots, p_k$ are the different prime factors of n.

SOLUTIONS OF PROBLEMS.

ALGEBRA.

471. Proposed by E. T. BELL, University of Washington.

If there is an infinite number of positive integers r for which the equation $\sum_{i=1}^{n} a_i^r = \sum_{i=1}^{m} b_i^r$ holds, where the a_i and b_i are given positive integers, prove that $m = n$, and that in some order the a_i are identical with the b_i.

472. Proposed by E. T. BELL, University of Washington.

If a_i and b_i $(i = 1, \cdots, n;\ j = 1, \cdots, m)$ denote positive integers, and if $\sum_{i=1}^{n} a_i^r = \sum_{j=1}^{m} b_j^r$ for all odd positive integral values of r, prove that $m = n$, and that in some order the a_i are identical with the b_j.

SOLUTION BY ELIJAH SWIFT, University of Vermont.

As the proof which I shall give covers both these problems, I shall not treat them separately.

Let a_1 be that a which is the largest of the a's and let there be k a's equal in value to a_1. Similarly b_1 is the largest b, and there are k' b's of the same value. (These exist since there is only a finite number of the a's and of the b's.) Now it is a well-known theorem that

$$\lim_{r=\infty} \Sigma a_i^r / k a_1^r = 1.$$

Since there is an infinite number of positive integers r for which the given equations hold, we can find an r as large as we please for which they hold. For such an r, $\Sigma a_i^r = k a_1^r + \delta k a_1^r$ and